What Is Claimed Is:

1. A method for using a computer system to solve a system of nonlinear equations specified by a vector function, **f**, wherein $\mathbf{f}(\mathbf{x}) = \mathbf{0}$ represents a set of nonlinear equations, $f_1(\mathbf{x}) = 0, f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \ldots, f_n(\mathbf{x}) = 0$, wherein $\mathbf{x}$ is a vector $(x_1, x_2, x_3, \ldots x_n)$, the method comprising:

receiving a representation of a subbox $\mathbf{X} = (X_1, X_2, \ldots, X_n)$, wherein for each dimension, i, the representation of X_i includes a first floating-point number, a_i, representing the left endpoint of X_i, and a second floating-point number, b_i, representing the right endpoint of X_i;

storing the representation in a computer memory;

applying term consistency to the set of nonlinear equations, $f_1(\mathbf{x}) = 0$, $f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \ldots, f_n(\mathbf{x}) = 0$, over **X**, and excluding portions of **X** that violate any of these nonlinear equations;

applying box consistency to the set of nonlinear equations over **X**, and excluding portions of **X** that violate any of the nonlinear equations; and

performing an interval Newton step on **X** to produce a resulting subbox **Y**, wherein the point of expansion of the interval Newton step is a point **x** within **X**, and wherein performing the interval Newton step involves evaluating $\mathbf{f}(\mathbf{x})$ using interval arithmetic to produce an interval result $\mathbf{f}^I(\mathbf{x})$.

2. The method of claim 1, wherein performing the interval Newton step involves:

computing $\mathbf{J}(\mathbf{x},\mathbf{X})$, wherein $\mathbf{J}(\mathbf{x},\mathbf{X})$ is the Jacobian of the function **f** evaluated as a function of **x** over the subbox **X**; and

determining if $\mathbf{J}(\mathbf{x},\mathbf{X})$ is regular as a byproduct of solving for the subbox **Y** that contains values of **y** that satisfy $\mathbf{M}(\mathbf{x},\mathbf{X})(\mathbf{y}-\mathbf{x}) = \mathbf{r}(\mathbf{x})$, where

$\mathbf{M}(\mathbf{x},\mathbf{X}) = \mathbf{B}\mathbf{J}(\mathbf{x},\mathbf{X})$, $\mathbf{r}(\mathbf{x}) = -\mathbf{B}\mathbf{f}(\mathbf{x})$, and $\mathbf{B}$ is an approximate inverse of the center of $\mathbf{J}(\mathbf{x},\mathbf{X})$.

3. The method of claim 2, further comprising:

applying term consistency to the preconditioned set of nonlinear equations $\mathbf{B}\mathbf{f}(\mathbf{x}) = \mathbf{0}$ over the subbox $\mathbf{X}$; and

excluding portions of $\mathbf{X}$ that violate the preconditioned set of nonlinear equations.

4. The method of claim 2, further comprising:

applying box consistency to the preconditioned set of nonlinear equations $\mathbf{B}\mathbf{f}(\mathbf{x}) = \mathbf{0}$ over the subbox $\mathbf{X}$; and

excluding portions of $\mathbf{X}$ that violate the preconditioned set of nonlinear equations.

5. The method of claim 1, wherein applying term consistency to the set of nonlinear equations involves:

for each nonlinear equation $f_i(\mathbf{x}) = 0$ in the system of equations $\mathbf{f}(\mathbf{x}) = \mathbf{0}$, symbolically manipulating $f_i(\mathbf{x})=0$ to solve for an invertible term, $g(x'_j)$, thereby producing a modified equation $g(x'_j)= h(\mathbf{x})$, wherein $g(x'_j)$ can be analytically inverted to produce an inverse function $g^{-1}(\mathbf{y})$;

substituting the subbox $\mathbf{X}$ into the modified equation to produce the equation $g(X'_j) = h(\mathbf{X})$;

solving for $X'_j = g^{-1}(h(\mathbf{X}))$; and

intersecting X'_j with the vector element X_j to produce a new subbox $\mathbf{X}^+$;

wherein the new subbox $\mathbf{X}^+$ contains all solutions of the system of equations $\mathbf{f}(\mathbf{x}) = \mathbf{0}$ within the subbox $\mathbf{X}$, and wherein the width of the new subbox $\mathbf{X}^+$ is less than or equal to the width of the subbox $\mathbf{X}$.

6. The method of claim 1, further comprising:

evaluating a first termination condition, wherein the first termination condition is TRUE if,

zero is contained within $\mathbf{f}^I(\mathbf{x})$,

$\mathbf{J}(\mathbf{x},\mathbf{X})$ is regular, wherein $\mathbf{J}(\mathbf{x},\mathbf{X})$ is the Jacobian of the function $\mathbf{f}$ evaluated as a function of $\mathbf{x}$ over the subbox $\mathbf{X}$, and

the solution $\mathbf{Y}$ of $\mathbf{M}(\mathbf{x},\mathbf{X})\,(\mathbf{y}\text{-}\mathbf{x}) = \mathbf{r}$ contains $\mathbf{X}$; and

if the first termination condition is TRUE, terminating and recording $\mathbf{X}$ as a final bound.

7. The method of claim 6, wherein the method further comprises:

evaluating a second termination condition;

wherein the second termination condition is TRUE if a function of the width of the subbox $\mathbf{X}$ is less than a pre-specified value, ε_X, and the width of the function $\mathbf{f}$ over the subbox $\mathbf{X}$ is less than a pre-specified value, ε_F; and

if the second termination condition is TRUE, terminating and recording $\mathbf{X}$ as a final bound.

8. A computer-readable storage medium storing instructions that when executed by a computer cause the computer to perform a method for using a computer system to solve a system of nonlinear equations specified by a vector function, $\mathbf{f}$, wherein $\mathbf{f}(\mathbf{x}) = \mathbf{0}$ represents a set of nonlinear equations, $f_i(\mathbf{x}) = 0$,

$f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \ldots, f_n(\mathbf{x}) = 0$, wherein $\mathbf{x}$ is a vector $(x_1, x_2, x_3, \ldots x_n)$, the method comprising:

receiving a representation of a subbox $\mathbf{X} = (X_1, X_2, \ldots, X_n)$, wherein for each dimension, i, the representation of X_i includes a first floating-point number, a_i, representing the left endpoint of X_i, and a second floating-point number, b_i, representing the right endpoint of X_i;

storing the representation in a computer memory;

applying term consistency to the set of nonlinear equations, $f_1(\mathbf{x}) = 0$, $f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \ldots, f_n(\mathbf{x}) = 0$, over $\mathbf{X}$, and excluding portions of $\mathbf{X}$ that violate any of these nonlinear equations;

applying box consistency to the set of nonlinear equations over $\mathbf{X}$, and excluding portions of $\mathbf{X}$ that violate any of the nonlinear equations; and

performing an interval Newton step on $\mathbf{X}$ to produce a resulting subbox $\mathbf{Y}$, wherein the point of expansion of the interval Newton step is a point $\mathbf{x}$ within $\mathbf{X}$, and wherein performing the interval Newton step involves evaluating $\mathbf{f}(\mathbf{x})$ using interval arithmetic to produce an interval result $\mathbf{f}^I(\mathbf{x})$.

9. The computer-readable storage medium of claim 8, wherein performing the interval Newton step involves:

computing $\mathbf{J}(\mathbf{x},\mathbf{X})$, wherein $\mathbf{J}(\mathbf{x},\mathbf{X})$ is the Jacobian of the function $\mathbf{f}$ evaluated as a function of $\mathbf{x}$ over the subbox $\mathbf{X}$; and

determining if $\mathbf{J}(\mathbf{x},\mathbf{X})$ is regular as a byproduct of solving for the subbox $\mathbf{Y}$ that contains values of $\mathbf{y}$ that satisfy $\mathbf{M}(\mathbf{x},\mathbf{X})(\mathbf{y}-\mathbf{x}) = \mathbf{r}(\mathbf{x})$, where $\mathbf{M}(\mathbf{x},\mathbf{X}) = \mathbf{BJ}(\mathbf{x},\mathbf{X})$, $\mathbf{r}(\mathbf{x}) = -\mathbf{Bf}(\mathbf{x})$, and $\mathbf{B}$ is an approximate inverse of the center of $\mathbf{J}(\mathbf{x},\mathbf{X})$.

10. The computer-readable storage medium of claim 9, wherein the method further comprises:

applying term consistency to the preconditioned set of nonlinear equations $\mathbf{Bf}(\mathbf{x}) = \mathbf{0}$ over the subbox $\mathbf{X}$; and

excluding portions of $\mathbf{X}$ that violate the preconditioned set of nonlinear equations.

11. The computer-readable storage medium of claim 9, wherein the method further comprises:

applying box consistency to the preconditioned set of nonlinear equations $\mathbf{Bf}(\mathbf{x}) = \mathbf{0}$ over the subbox $\mathbf{X}$; and

excluding portions of $\mathbf{X}$ that violate the preconditioned set of nonlinear equations.

12. The computer-readable storage medium of claim 8, wherein applying term consistency to the set of nonlinear equations involves:

for each nonlinear equation $f_i(\mathbf{x}) = 0$ in the system of equations $\mathbf{f}(\mathbf{x}) = \mathbf{0}$, symbolically manipulating $f_i(\mathbf{x})=0$ to solve for an invertible term, $g(x'_j)$, thereby producing a modified equation $g(x'_j)= h(\mathbf{x})$, wherein $g(x'_j)$ can be analytically inverted to produce an inverse function $g^{-1}(\mathbf{y})$;

substituting the subbox $\mathbf{X}$ into the modified equation to produce the equation $g(X'_j) = h(\mathbf{X})$;

solving for $X'_j = g^{-1}(h(\mathbf{X}))$; and

intersecting X'_j with the vector element X_j to produce a new subbox $\mathbf{X}^+$;

wherein the new subbox $\mathbf{X}^+$ contains all solutions of the system of equations $\mathbf{f}(\mathbf{x}) = \mathbf{0}$ within the subbox $\mathbf{X}$, and wherein the width of the new subbox $\mathbf{X}^+$ is less than or equal to the width of the subbox $\mathbf{X}$.

13. The computer-readable storage medium of claim 8, wherein the method further comprises:

evaluating a first termination condition, wherein the first termination condition is TRUE if,

zero is contained within $\mathbf{f}^{I}(\mathbf{x})$,

$\mathbf{J}(\mathbf{x},\mathbf{X})$ is regular, wherein $\mathbf{J}(\mathbf{x},\mathbf{X})$ is the Jacobian of the function $\mathbf{f}$ evaluated as a function of $\mathbf{x}$ over the subbox $\mathbf{X}$, and

the solution $\mathbf{Y}$ of $\mathbf{M}(\mathbf{x},\mathbf{X})\,(\mathbf{y}-\mathbf{x}) = \mathbf{r}$ contains $\mathbf{X}$; and

if the first termination condition is TRUE, terminating and recording $\mathbf{X}$ as a final bound.

14. The computer-readable storage medium of claim 13, wherein the method further comprises:

evaluating a second termination condition;

wherein the second termination condition is TRUE if a function of the width of the subbox $\mathbf{X}$ is less than a pre-specified value, ε_X, and the width of the function $\mathbf{f}$ over the subbox $\mathbf{X}$ is less than a pre-specified value, ε_F; and

if the second termination condition is TRUE, terminating and recording $\mathbf{X}$ as a final bound.

15. An apparatus that solves a system of nonlinear equations specified by a vector function, $\mathbf{f}$, wherein $\mathbf{f}(\mathbf{x}) = \mathbf{0}$ represents a set of nonlinear equations, $f_1(\mathbf{x}) = 0, f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \ldots, f_n(\mathbf{x}) = 0$, wherein $\mathbf{x}$ is a vector $(x_1, x_2, x_3, \ldots x_n)$, the apparatus comprising:

a receiving mechanism that is configured to receive a representation of a subbox $\mathbf{X} = (X_1, X_2, \ldots, X_n)$, wherein for each dimension, i, the representation of

X_i includes a first floating-point number, a_i, representing the left endpoint of X_i, and a second floating-point number, b_i, representing the right endpoint of X_i;

a computer memory for storing the representation;

a term consistency mechanism that is configured to apply term consistency to the set of nonlinear equations, $f_1(\mathbf{x}) = 0$, $f_2(\mathbf{x}) = 0, f_3(\mathbf{x}) = 0, \ldots, f_n(\mathbf{x}) = 0$, over **X**, and to exclude portions of **X** that violate any of these nonlinear equations;

a box consistency mechanism that is configured to apply box consistency to the set of nonlinear equations over **X**, and to exclude portions of **X** that violate any of the nonlinear equations; and

an interval Newton mechanism that is configured to perform an interval Newton step on **X** to produce a resulting subbox **Y**, wherein the point of expansion of the interval Newton step is a point **x** within **X**, and wherein performing the interval Newton step involves evaluating **f(x)** using interval arithmetic to produce an interval result $\mathbf{f}^I(\mathbf{x})$.

16. The apparatus of claim 15, wherein the interval Newton mechanism is configured to:

compute **J(x,X)**, wherein **J(x,X)** is the Jacobian of the function **f** evaluated as a function of **x** over the subbox **X**; and

determine if **J(x,X)** is regular as a byproduct of solving for the subbox **Y** that contain the values of **y** that satisfy **M(x,X)(y-x)** = **r(x)**, where **M(x,X)** = **BJ(x,X)**, **r(x)** = **-Bf(x)**, and **B** is an approximate inverse of the center of **J(x,X)**.

17. The apparatus of claim 16, wherein the term consistency mechanism is configured to:

apply term consistency to the preconditioned set of nonlinear equations $\mathbf{Bf}(\mathbf{x}) = \mathbf{0}$ over the subbox $\mathbf{X}$; and to

exclude portions of $\mathbf{X}$ that violate the preconditioned set of nonlinear equations.

18. The apparatus of claim 16, wherein the box consistency mechanism is configured to:

apply box consistency to the preconditioned set of nonlinear equations $\mathbf{Bf}(\mathbf{x}) = \mathbf{0}$ over the subbox $\mathbf{X}$; and to

exclude portions of $\mathbf{X}$ that violate the preconditioned set of nonlinear equations.

19. The apparatus of claim 15, wherein for each nonlinear equation $f_i(\mathbf{x}) = 0$ in the system of equations $\mathbf{f}(\mathbf{x}) = \mathbf{0}$, the term consistency mechanism is configured to:

symbolically manipulate $f_i(\mathbf{x})=0$ to solve for an invertible term, $g(x'_j)$, thereby producing a modified equation $g(x'_j)= h(\mathbf{x})$, wherein $g(x'_j)$ can be analytically inverted to produce an inverse function $g^{-1}(\mathbf{y})$;

substitute the subbox $\mathbf{X}$ into the modified equation to produce the equation $g(X'_j) = h(\mathbf{X})$;

solve for $X'_j = g^{-1}(h(\mathbf{X}))$; and to

intersect X'_j with the vector element X_j to produce a new subbox $\mathbf{X}^+$;

wherein the new subbox $\mathbf{X}^+$ contains all solutions of the system of equations $\mathbf{f}(\mathbf{x}) = \mathbf{0}$ within the subbox $\mathbf{X}$, and wherein the width of the new subbox $\mathbf{X}^+$ is less than or equal to the width of the subbox $\mathbf{X}$.

20. The apparatus of claim 15, further comprising a termination mechanism that is configured to:

evaluate a first termination condition, wherein the first termination condition is TRUE if,

zero is contained within $\mathbf{f}^{I}(\mathbf{x})$,

$\mathbf{J}(\mathbf{x},\mathbf{X})$ is regular, wherein $\mathbf{J}(\mathbf{x},\mathbf{X})$ is the Jacobian of the function **f** evaluated as a function of **x** over the subbox **X**, and

the solution **Y** of $\mathbf{M}(\mathbf{x},\mathbf{X})\ (\mathbf{y}-\mathbf{x}) = \mathbf{r}$ contains **X**; and to

terminate and record **X** as a final bound if the first termination condition is TRUE.

21. The apparatus of claim 20, wherein the termination mechanism is additionally configured to:

evaluate a second termination condition;

wherein the second termination condition is TRUE if a function of the width of the subbox **X** is less than a pre-specified value, ε_X, and the width of the function **f** over the subbox **X** is less than a pre-specified value, ε_F; and to

terminate and record **X** as a final bound if the second termination condition is TRUE.